Claims

[c1] 1.A method for manufacturing an article for use in a high-temperature environment, said method comprising:
providing a substrate;
selecting a desired vertical crack density for a protective coating to be deposited on said substrate;
providing a powder, wherein said powder has a particle size distribution selected to provide a thermal spray coating having said desired vertical crack density; and
applying a thermal-sprayed coating to said substrate, said coating having said desired vertical crack density, wherein said powder is used as a raw material for said coating.

[c2] 2.The method of claim 1, wherein selecting said desired vertical crack density comprises selecting a vertical crack density from about 0 cracks per linear centimeter of coating to about 30 cracks per linear centimeter of coating.

[c3] 3.The method of claim 2, wherein selecting said vertical crack density comprises selecting a vertical crack density from about 0 cracks per linear centimeter of coating to about 12 cracks per linear centimeter of coating.

[c4] 4.The method of claim 3, wherein selecting said vertical crack density comprises selecting a vertical crack density of about 0 cracks per inch of coating.

[c5] 5.The method of claim 1, wherein providing said powder comprises providing a powder having a particle size distribution wherein
about 10 volume percent of said powder comprises particles having diameters less than a tenth percentile diameter value in the range from about 25 micrometers to about 50 micrometers,
about 50 volume percent of said powder comprises particles having diameters less than a fiftieth percentile diameter value in the range from about 50 micrometers to about 70 micrometers, and
about 90 volume percent of said powder comprises particles having diameters less than a ninetieth percentile diameter value in the range from about 85 micrometers to about 105 micrometers.

[c6] 6.The method of claim 5, wherein providing said powder comprises providing a powder having a particle size distribution wherein
said tenth percentile diameter value is in the range from about 25 micrometers to about 30 micrometers,
said fiftieth percentile diameter value is in the range from about 50 micrometers to about 55 micrometers, and
said ninetieth percentile diameter value is in the range from about 85 micrometers to about 90 micrometers.

[c7] 7.The method of claim 5, wherein providing said powder comprises providing a powder having a particle size distribution wherein
said tenth percentile diameter value is in said range from about 35 micrometers to about 50 micrometers,
said fiftieth percentile diameter value is in said range from about 55 micrometers to about 70 micrometers, and
said ninetieth percentile diameter value is in said range from about 85 micrometers to about 105 micrometers.

[c8] 8.The method of claim 7, wherein providing said powder comprises providing a powder having a particle size distribution wherein
said tenth percentile diameter value is in the range from about 35 micrometers to about 45 micrometers,
said fiftieth percentile diameter value is in the range from about 55 micrometers to about 65 micrometers, and
said ninetieth percentile diameter value is in the range from about 85 micrometers to about 90 micrometers.

[c9] 9.The method of claim 7, wherein providing said powder comprises providing a powder having a particle size distribution wherein
said tenth percentile diameter value is in the range from about 45 micrometers to about 50 micrometers,
said fiftieth percentile diameter value is in the range from about 60 micrometers to about 70 micrometers, and
said ninetieth percentile diameter value is in the range from about 95

micrometers to about 105 micrometers.

[c10] 10.The method of claim 1, wherein providing said substrate comprises providing a material comprising silicon.

[c11] 11.The method of claim 10, wherein providing said material comprises providing at least one of a silicon-containing ceramic and a silicon-containing metal alloy.

[c12] 12.The method of claim 11, wherein providing said ceramic comprises providing a fiber-reinforced composite material.

[c13] 13.The method of claim 1, wherein providing said substrate further comprises providing a component of a gas turbine assembly.

[c14] 14.The method of claim 1, wherein providing said powder comprises providing a material capable of forming an environmental barrier layer to protect said substrate from a high temperature environment.

[c15] 15.The method of claim 14, wherein providing said powder comprises providing a ceramic material.

[c16] 16.The method of claim 15, wherein providing said ceramic material comprises providing a material comprising barium strontium aluminosilicate.

[c17] 17.The method of claim 1, wherein applying said thermal-sprayed coating comprises applying a coating having a thickness of greater than about 20 micrometers.

[c18] 18.The method of claim 17, wherein applying said thermal-sprayed coating comprises applying a coating having a thickness in the range from about 100 micrometers to about 1500 micrometers.

[c19] 19.The method of claim 1, further comprising applying at least one intermediate layer onto said substrate prior to applying said thermal-sprayed coating.

[c20] 20.The method of claim 19, wherein applying said at least one intermediate

layer comprises applying at least one layer comprising mullite.

[c21] 21.The method of claim 19, wherein applying said at least one intermediate layer comprises applying at least one layer comprising silicon.

[c22] 22.The method of claim 1, further comprising heat-treating said substrate after applying said thermal-sprayed coating.

[c23] 23.The method of claim 21, wherein heat-treating comprises heating said substrate to a temperature in the range from about 1200 ° C to about 1400 ° C for a time in the range from about 15 minutes to about 100 hours.

[c24] 24.The method of claim 1, wherein applying said thermal-sprayed coating comprises applying said coating using at least one of air plasma spraying, vacuum plasma spraying, and high-velocity oxy-fuel spraying.

[c25] 25.The method of claim 1, wherein providing said powder comprises providing a material capable of forming a thermal barrier layer to protect said substrate from a high temperature environment.

[c26] 26.The method of claim 25, wherein providing said powder comprises providing a ceramic powder.

[c27] 27.The method of claim 26, wherein providing said ceramic powder comprises providing a material comprising yttria-stabilized zirconia.

[c28] 28.A method for manufacturing an article for use in a high-temperature environment, said method comprising:
providing a substrate comprising silicon;
selecting a desired vertical crack density for an environmental barrier coating to be deposited on said substrate;
providing a powder comprising barium strontium aluminosilicate, wherein said powder has a size range selected to provide a coating having said desired vertical crack density; and
applying a thermal-sprayed coating to said substrate, said coating having said selected vertical crack density, wherein said powder is used as a raw material for said coating.

[c29] 29.An article for use in high temperature environments, said article comprising:
a substrate comprising silicon; and
an environmental barrier coating comprising barium aluminosilicate, wherein said coating comprises a vertical crack density of greater than about 4 cracks per linear centimeter of coating.

[c30] 30.The article of claim 29, wherein said vertical crack density is in the range from about 4 cracks per linear centimeter of coating to about 12 cracks per linear centimeter of coating.

[c31] 31.The article of claim 29, wherein said substrate comprises at least one of a silicon-containing ceramic and a silicon-containing metal alloy.

[c32] 32.The article of claim 31, wherein said substrate comprises a fiber-reinforced composite material.

[c33] 33.The article of claim 29, wherein said substrate comprises a component of a gas turbine assembly.

[c34] 34.The article of claim 29, further comprising at least one intermediate layer disposed between said substrate and said environmental barrier coating.

[c35] 35.The article of claim 34, wherein said at least one intermediate layer comprises at least one of mullite and silicon.